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ABSTRACT

The aim of this investigation was to determine whether biology majors' and non-biology majors' attitudes toward biology are changed as a result of a single semester of instruction in biology. This study also attempted to determine the direction, degree, and possible correlates of this modification. The Biology Attitude Scale was administered at the beginning and conclusion of two non-biology majors courses and three biology majors courses. Biology majors had significantly more positive entering attitudes toward biology than did the non-biology majors; however, all groups except the biology honors-section had decreased in positive attitudes by the end of the term. Although the decrease was not statistically significant, it was sufficient to result in statistically indistinguishable leaving-attitudes as evaluated by analysis of covariance. This study also demonstrated that the students' attitudes toward biology are only minimally related to such well-defined ideographic characteristics as gender and age. (Author)

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ATTITUDE MODIFICATION

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The aim of this investigation was to determine if biology majors' and non-biology majors' attitudes toward biology are changed as a result of a single semester of instruction in biology. This study also attempted to determine the direction, degree and possible correlates of this modification.

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This study also demonstrated that the students' attitudes toward biology are only minimally related to such well-defined ideographic characteristics such as gender and age.

Two basic purposes of teaching any subject are (1) to increase the student's knowledge, and (2) to increase favorable attitudes toward the subject. Instructors routinely test for the former and assume the latter.

Although there may be a positive correlation between achievement and attitudes, as some research seems to suggest, this relationship has not been firmly established and should not be assumed to exist, even if a particular program has demonstrated acceptable student achievement gains. It is conceivable that a student who has demonstrated high achievement on tests may have developed strong negative attitudes toward the subject; the converse may be true also. The promotion of negative attitudes toward science is particularly undesirable in an age where the populace has become jaded with scientific advancements and distrustful of scientific research.

Traditionally, American education has maintained that an important function of education is the promotion, cultivation and development of such attributes as interests, appreciation and desirable attitudes. However, in practice, the development of verbal conceptual skills has received the highest teaching proprities often to the detriment of affective goals. (3) The emphasis on performance objectives has increased concern over cognitive gain, possibly at the expense of goals in the affective domain. There are several interrelated causes that may account for this situation. The technological demands of society gear education to the production of individuals who can deal effectively with abstract and concrete concepts as well as mathematical or scientific symbols. These skills can be taught through the communication of specific and generalized information and

through the development of inductive and deductive modes of thought (1) techniques which are well-founded in standard teaching methodology and are a part of the instructional repertoire of every skilled teacher. In addition, these skills can be measured readily by conventional means, e.g., essay or multiple choice test questions on teacher-made or standardized examinations. (4)

Behaviors in the affective domain are neither easily taught nor readily measured, and some educators perceive Orwellian overtones in any instructional emphasis on the achievement of affective outcomes. (1) Teaching with the intention of attitude modification is sometimes viewed as indoctrination rather than education--as if these two comprise a real and clear dichotomy. However, a clear distinction should be made between those attitudes acquired together with cognitive outcomes and those associated with moral values which, in fact, cannot be taught with cognitive techniques (7) and which are not the subject of this study.

In addition to the difficulty in developing curricula that will promote goals in the affective domain, another reason for the neglect of this area may be that the usual teacher-made test and standardized achievement tests are oriented exclusively to measuring and comparing cognitive outcomes among particular groups of students. Reasoned arguments are given for the extensive use of these tests to the exclusion of affective instruments. Some educators assume that affective modification, unlike cognitive gains, cannot be accomplished in an instructional period of a week or even a semester. (1) There is evidence, however, that many affective objectives can be attained relatively quickly and are, therefore, measurable at the conclusion of instruction. (1, 6, 7). Affective outcomes may be ignored

because of the notion that attutudes are private and should not be recorded (1) even though attitudes can be demonstrated to affect cognitive achievement. Ideally, when a student performs below his ability level, attempts are made to diagnose and correct the deficiency; however, although teachers may suspect and even complain about "poor" attitudes among their students, little is done to improve this situation.

RATIONAL AND PROCEDURES The development of desirable attitudes toward biology is not the major goal of the introductory majors and non-majors biology courses at East Texas State University, but the instructors recognize that attitude formation is one of the important aspects of instruction. The objective of this research was (1) to determine the attitude changes that occur as a result of instruction in the biology majors and non-biology majors biology courses, and (2) to determine the direction of this change.

The following research questions were addressed:

1. Do biology majors or non-biology majors have better entering attitudes toward biology?
2. Does the course of instruction promote attitude modification in biology majors and non-biology majors?
3. Is there a greater attitude modification in biology majors or non-biology majors?
4. Can the modification of attitudes of biology majors and non-biology majors be correlated with certain student ideographic characteristics?

The population for this study consisted of the students enrolled in the nine sections of Biology 140 non-majors (Class 1), seven sections of

Biology 142 non-majors (Class II), and three sections of Biology 101 majors, (Classes III, IV, & V). One of the sections of Biology 101 (Class III) was an honors section for high ability students. Data was collected during the Fall semester and the study was repeated with the spring semester Biology 140 students.

Both the Biology 140 and Biology 141 courses employ the Audio-Tutorial approach patterned after the system developed by S.W. Postlethwait. (5) Biology 140 consists of 13 units emphasizing an ecological approach while Biology 141 has 14 units emphasizing human anatomy and physiology. Biology 101 is a "traditional" majors course taught by the lecture-lab method.

VARIABLES The dependent variables were the attitude modification resulting from insturction in each biology course as measured by the Biology Attitude Scale and the final grades earned in each course. The independent variables were the biology course and certain ideographic attributes e.g., sex, age, and major. The Biology Attitude Scale was developed by Russell and Hollander and has a reported concurrent validity of 0.80. The scale consists of 22 items divided into two sections, one a series of 14 Likert-type items, the other a series of eight sementic differential items. The test-retest reliability was 0.80 for the Likert items and 0.90 for the semantic differential section. In this study the Biology Attitude Scale was used to measure changes in attitudes toward biology and to compare attitudes among the various groups. (6).

EXPERIMENTAL DESIGN The experimental design was basically a one-group pretest-posttest procedure. (2) This design provides a comparison by the same group before and after exposure to the experimental treatment, i.e.,

biology course, and it also provides a control for certain internal validity problems e.g., selection bias. (2) This design also provides a means for comparing the attitude outcomes of different groups by establishing a factor (pretest) that can be used as a covariate to adjust the measurements on the variate (posttest). This capability is particularly important under the conditions prevailing in this study where the groups could not be assigned at random to the experimental conditions.

The student "t" test was used to evaluate the first experimental question. The second experimental question was analyzed with a matched-pair "t" test. Analysis of covariance was used to evaluate the third experimental question and correlations were performed to evaluate the last experimental question.

TABLE 1.

SUMMARY OF RESULTS ON THE BIOLOGY ATTITUDE SCALE

CLASS	N	PRETEST MEAN	S.D.	POSTTEST MEAN	S.D.
I	142	75.96	11.07	75.92	15.39
II	35	78.57	14.09	75.40	13.70
III	6	93.00	7.04	93.50	8.85
IV	71	81.04	13.04	79.44	14.23
V	49	83.59	14.09	82.65	14.74

TABLE 2

RESULTS OF ANALYSIS OF MATCHED PAIR "t" TEST EVALUATION OF POST ATTITUDE SCORES

CLASS	D.F.	D.	S.D.	t	P
I	141	-0.05	12.37	-0.05	0.96
II	34	-3.23	10.23	-1.87	0.07
III	3	0.50	10.37	0.12	0.91
IV	70	-1.61	11.4922	-1.18	0.24
V	48	-0.94	10.15	-0.65	0.52

TABLE 3

ANALYSIS OF COVARIANCE EVALUATION OF ATTITUDE POSTSCORES USING ATTITUDE PRESCORES AS THE COVARIATE

CLASS COMPARISONS	SOURCE OF VARIANCE	D.F.	F.	P.
I vs II	Equality of Means	1	1.38	0.240
	Zero Slope	1	113.46	0.000
	Error	175		
	Equality of Slopes	1	0.64	0.420
	Error	174		
I vs II, IV, V.				
	Equality of Adj. Means	1	0.02	0.880
	Zero Slope	1	193.28	0.000
	Error	266		
	Equality of Slope	1	0.66	0.420
	Error	265		

II vs III, IV, V.

Equality of Adj. Means	1	2.34	0.130
Zero Slope	1	155.93	0.000
Error	158		
Equality of Slope	1	0.09	0.760
Error	157		

I & II vs. III, IV, V.

Source of Variation	DF	F	P
Equality of Means	2	13.72	0.000
Error	139		

RESULTS As expected, biology majors have more positive entering attitudes toward biology than do the non-majors (See Table 1). Analysis of variance indicates this difference to be highly significant, $F(2, 139) = 13.72$ $P < 0.001$ (See Table 3). Contrast analysis of this data indicates that the students enrolled in the two non-majors courses do not differ significantly in their entering attitudes, $t(175) = 1.60$: $P = 0.11$, although their combined data does differ significantly from the majors combined data, $t(177) = 3.33$: $P = 0.001$.

The matched-pair "t" test was used to evaluate the second research question because the correlated nature of pre-post scores makes the independent "t" test inappropriate. The results of this analysis are reported in table 2. All classes except the majors honors class experienced a decrease in attitudes toward biology as can be seen from the negative "t" values. However, none of these changes including the positive change in the honors class was significant.

A cursory examination of the mean attitude postscores reported in table 1 would seem to indicate that biology majors completing a majors introductory course develop better attitudes toward biology than do non-majors completing the non-majors course. However, once the postscore means are adjusted for the prescore means in an analysis of covariance, there is no significant difference in attitude postscores between majors and non-majors.

Certain ideographic information was collected on students in Biology 140 in an effort to determine possible functional relationships between these variables and the attitude prescores and postscores. Multiple linear regression analysis was employed in this evaluation. The final model tested contained information on students' sex, age and classification and was formulated as follows:

Attitude Prescore = B + sex + age + classification

The mutliple R for this model was only 0.46, indicating that a knowledge of the students' sex, age and classification accounts for only 21% of the variance inherent in the prescore. Adding information to the model in the form of the number of science courses the student had in high school and the size of his high school--an indirect indication of the facilities available to him in high school--produced the following model:

Attitude prescore = sex + age + classification + science courses + student number.

This model produced a multiple R of 0.60 and accounts for a respectable 37% of the variance inherent in the attitude prescores.

A similiar attempt was made to determine the functional relationship between these students' characteristics and attitude postscores. The first model tested was:

Attitude postscore + sex + age + classification

This model produced a mutliple R of 0.56 and accounted for 32% of the variance in the attitude postscores. Inclusion of science courses and number of students in their high school improved the multiple R to only 0.62 with 39% of the variance of attitude postscores accounted for in this model.

INTERPRETATIONS AND INFERENCES: The lower entering-attitude scores measured for the non-biology majors in comparison to those achieved by the biology majors was not surprising. Non-science majors must complete two semesters of science in order to meet the General Studies requirements for graduation. Although they could elect to take earth science, chemistry or physics, the majority enroll in biology perhaps because they had some biology in high school and assume this to be the lesser of several "evils."

This study demonstrated that majors as well as non-majors tend to experience a decrease in their attitudes toward biology to the extent that the effects of these courses on attitudes toward biology become statistically indistinguisable. The important point is that an affective change can occur within an instructional period and this change can be detected and measured. It should be possible to monitor a course for its effect on student attitudes and take corrective measures.

This study also demonstrated that students' attitudes toward biology are only minimally related to well-defined student characteristics such as sex and age. A large portion of the variance inherent in students' attitude, from 63 to 79% is due to undetermined variables.

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